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ABSTRACT

This environmental unit is one of a series designed for integration within an existing curriculum. The units are self-contained and require minimal teacher preparation. The philosophy behind the units is based on an experience-oriented process that encourages self-paced independent work. This unit on shadows is designed for all elementary levels, grades 1-8. The activities become progressively more sophisticated, making some more suitable at different levels. In the first section, the goal is for students to explore the concept of spatial relationships through play activities with shadows. The games include shadow tag and keep away, shadow plays, and mystery shadows. The activities of the second section are concerned with shadows caused by sun and earth movements, and with the effects of shade on the life of plants and animals. Activities include studying the passage of time as indicated by shadows, determining the height of a pole by shadow calculations, and investigating the effects of shade on green plants. Each activity in the unit includes a list of materials needed, directions, and questions for discussion. (MA)

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Shadows

An Environmental Investigation

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THE ENVIRONMENTAL UNITS

This is one of a group of Environmental Units written by the Environmental Science Center and published by the National Wildlife Federation.

In both theory and practice education is the essential base for long-range local, regional and national programs to improve and maintain the quality of environment necessary for man's welfare and survival. Citizens must be aware of ecological relationships in order to recognize, appreciate and fulfill constructive roles in society. This awareness should be launched through the existing educational process—in classroom and related school activities. No special courses on ecology can replace the need to integrate ecological learning throughout the existing curricula of our school systems. Furthermore, the life-styles and value-systems necessary for rational environmental decisions can best be acquired through repeated exposure to ecological learning which pervades the total educational experience.

It was with these thoughts that we developed these curriculum materials. They were designed for the classroom teacher to use with a minimal amount of preparation. They are meant to be part of the existing curriculum--to complement and enhance what students are already experiencing. Each unit is complete in itself, containing easy-to-follow descriptions of objectives and methods, as well as lists of simple materials.

The underlying philosophy throughout these units is that learning about the environment is not a memorization process, but rather an experience-oriented, experiment-observation-conclusion sort of learning. We are confident that students at all levels will arrive at intelligent ecological conclusions if given the proper opportunities to do so, and if not forced into "right" answers and precisely "accurate" names for their observations. If followed in principle by the teacher, these units will result in meaningful environmental education.

In the process of development, these units have been used and tested by classroom teachers, after which they have undergone evaluations, revisions and adaptations. Further constructive comments from classroom teachers are encouraged in the hope that we may make even more improvements.

A list of units in this group appears on the inside back cover.

About the National Wildlife Federation—1412 Sixteenth Street, N.W., Washington, D.C. 20036

Founded in 1936, the National Wildlife Federation has the largest membership of any conservation organization in the world and has affiliated groups in each of the 50 states, Guam, and the Virgin Islands. It is a non-profit, non-governmental organization devoted to the improvement of the environment and proper use of all natural resources. NWF distributes almost one million copies of free and inexpensive educational materials each year to youngsters, educators and concerned citizens. Educational activities are financed through contributions for Wildlife Conservation Stamps.

About the Environmental Science Center—5400 Glenwood Avenue, Minneapolis, Minnesota 55422

The Environmental Science Center, established in 1967 under Title III of the Elementary and Secondary Education Act is now the environmental education unit of the Minnesota Environmental Sciences Foundation, Inc. The Center works toward the establishment of environmental equilibrium through education—education in a fashion that will develop a conscience which guides man in making rational judgments regarding the environmental consequences of his actions. To this end the Environmental Science Center is continuing to develop and test a wide variety of instructional materials and programs for adults who work with youngsters.

Shadows

An Environmental Investigation

BY

NATIONAL WILDLIFE FEDERATION

MINNESOTA ENVIRONMENTAL SCIENCES FOUNDATION, INC.

Design and Illustrations by
JAN BLYLER

When children explore shadows they are experimenting with spatial relationships. Enabling students to discern spatial relationships is the goal throughout the play activities of **Shadows.**

The unit also has a very direct application to ecology in that shade affects living things. The children will investigate this effect late in the unit by examining the difference in numbers and types of plants in shaded and sunny areas. Students will find that shading from sunlight has an important effect on the ecology of an area.

The objectives of this unit, therefore, are simple but critical. We hope that early primary school children will:

1) explore shadows and experiment with spatial relationships, and
2) understand that shadows change according to the position of the light source.

The second and third sections of this unit are probably more appropriate for grades five through eight. The goal for these late primary school children is that they:

1) learn about sun and earth movement by investigating shadows, and
2) understand the effects of shade on the life of plants and animals.

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INTRODUCTION

The unit begins with a series of play activities, some indoors, some outdoors, which give the younger children or beginners an understanding of the nature of shadows. The students will find that shadows are caused by a **light source** and an **object** which blocks the light from that source. They will see that the **size** and **shape** of the shadow depends upon the location of the light source in relation to the object. These are essential concepts for a child to grasp before developing more sophisticated understandings of shadows. The "larger" concepts will also be investigated, in later activities of this unit.

It is important for children to discover that shadows are predictable. The children will find they can predict the length and direction of a shadow at certain times of the day, and at different times of the year. This not only gives them a feel for patterns in nature but also generates an understanding of earth and sun movement. For example, they will see why a noon shadow is always shorter than one at any other time, and why a noon shadow in the northern hemisphere always points north. The children must begin to recognize the movement of the earth in relation to the sun, to account for these happenings. To help make this association they will make use of a globe and a lamp.

MATERIALS

large objects with simple outlines
chalk
pavement
bed sheets
lamp with 150-200 watt, clear light bulb
tape
white paper
table
coat hangers
bag or box
stationary object
cardboard
stakes
crayons
world globes
clay
yardsticks
clipboards
flagpole
toothpicks
map of time zones
pins
stick figures
string
compasses

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Shadows

PLAYFUL SHADOWS

Some fun games to play can also be learning experiences of significance. The following examples are designed to acquaint the children with shadows and how they function. The concepts are simple, but will probably be better grasped by the children if discovered through playing games.

I. Outdoors

A. Shadow tag

1. The person who is "it" tries to touch his shadow to another player's shadow,

or

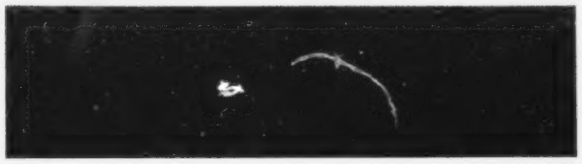
2. The person who is "it" tries to step on another player's shadow.

In either version 1 or 2, use a stationary shadow (from a building, tree, etc.) as a safety place.

B. Shadow keep away

Ask the class to stay within a limited area (tennis court, etc.). Have each child choose a partner who will try to step on his shadow. The object of the game is to prevent this from happening. When it does happen the partners can switch roles ("hunter" becomes "hunted").

C. Shadow, how many shapes do you have?



1. Have each child bring to school a large, light object with a **simple** outline. (For example, garbage can covers, hoola hoops, umbrellas, brooms, inner tubes, cardboard boxes, etc.)
2. Divide the class into teams of two children each, provide each team with chalk, and have the teams spread out over a parking lot or some other paved area.
3. One child manipulates one of the objects and the other child sketches the outline of his shadow on the pavement with chalk.
4. Ask the children how many different shapes they can make with the shadows of their objects.
   a. How large or small can they make the object's shadow?
   b. How skinny or fat can they make the object's shadow?
   c. How dark and crisp can they make the object's shadow?
   d. How faded and fuzzy can they make the object's shadow?

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D. Shadow people

1. Have each team of two children make sketches of the shadows of their own bodies while they assume different positions. Team members can take turns being the person who outlines the shadows with chalk. Can they make monster people? Can they make a shadow with their body which doesn't look like a person at all?
2. Make groups of four children each by pairing up the teams. Ask the team members to take turns being the person who outlines the shadows with chalk. The other three children should construct some design or picture using their shadows. Can they make an unusual design that doesn't look like three children? Can they make an animal like a giraffe or maybe make up a new animal out of their imagination? Can three people stand in a line so the shadow looks like only one person?

II. Indoors

A. Your hands can make strange shadows

1. Set a 150-200 watt lamp, without a shade, in the center of the room. Have each team tape a 3′ x 3′ piece of white paper on the wall.
2. Shut off all lights but the one in the center of the room. Draw the blinds and ask the teams to create designs, animals, etc., on the white paper.
3. As each team member creates a new design, the other member can sketch around the shadow on the paper.

B. Stage a shadow play

1. Build a stage by hanging a sheet in a doorway or on a frame. Put a strong light source behind it (slide projector or lamps).
2. Have each team think of some kind of activity they can perform behind the screen. Here are some suggestions:

   Boxing—Two children stand behind the screen, one closer to the sheet than the other, for safety. Both children then make boxing gestures. Since the shadows both fall on the same screen, it looks like they are facing one another.

An Operation—The "doctor" removes books, pencils, etc. from the "patient." (Have the children figure out how to do this for themselves.)

3. Put a table behind the screen and have the children create and perform their own dramas using cut-out figures, or small figurines and playthings from home. The figures could be taped or glued to handles made out of coat hangers. These plays might be taken from their reading book or might relate to some other subject they are studying, such as social studies. Place the light source on one side of the stage so that the shadows of the children's bodies are less apt to show. Do they realize that the closer they hold their characters to the screen, the sharper and darker are the shadows which their audience sees?

C. Mystery objects

1. Have the children bring a "mystery object" from home, concealed in a bag or box. It should be some common household object. Have each child draw a number from a hat the day before, and tape his number to his object. The children should keep their numbers secret for the time being.
2. Each child uses his mystery object to cast four different shadows on the sheet of the shadow stage. One bottle, for example, might cast all the following shadows:

The rest of the class writes down the child's name and makes notes or drawings of the shadows.

3. After projecting its shadow, each child deposits his mystery object in a box, taking care that the class cannot see it. The teacher holds a cloth over the box so that no one can see the other mystery objects which the box contains.
4. After all the members of the class have had a chance to project the shadows of their objects on the screen, the teacher displays all the materials on a table.
5. The children look at the objects and try to match each one with its owner, by writing the number of the object next to the name of the child they think owns it.
6. After a few minutes, the teacher can go over each object and ask who showed it. Some students may have had problems with certain objects. The class can discuss why the shadows of some may have been harder to guess than others.

As an alternative, each child can bring in two or three objects which the teacher will collect and number. The mystery pieces should then be doled out, one per child. The advantage here is that the teacher can sort out the types of objects which are used, with an eye toward greater variety. She could also limit the selection to one type of object, such as bottles, if circumstances make this desirable.

SHADOWS WHICH ANSWER QUESTIONS

I. Shadow, what time is it?

A. Have the class observe that a shadow from the sun changes position with the time of day. **Remember** to make allowances for daylight saving time, especially for the sun clock activity in section **C** which follows. It is best to be consistent—use the same time system throughout the year or the children will be misled about the time of the shortest shadow.

1. Have each team select and study the shadow movement of one or two objects:
   a. Have a team member use chalk to mark the movement of the shadow of the school building once every two hours during the day.
   b. Have each child stand in a separate spot and mark the position of his feet by drawing

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around them with chalk. Then have the students mark the change in length of their own shadows from that position, once every two hours during the day.

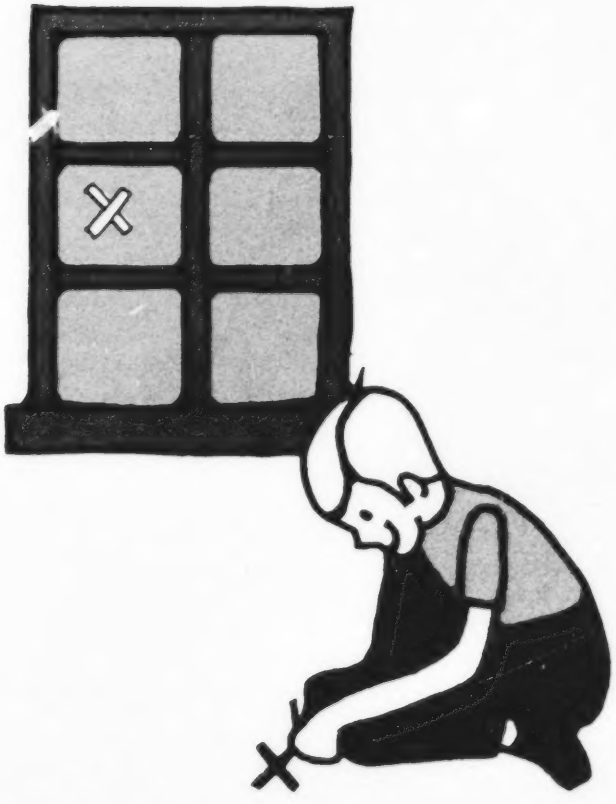
c. Have team members mark the change in length of the shadow of some small stationary object such as a twig.

2. To predict where a shadow will fall, have each team select and study the shadow of an object as in part **A**-1 above. After marking the shadow's position twice, have them predict where it will fall in two hours. After the two hours, see how close each student came with his prediction.

B. Have the class mark the change of a shadow's position over a period of time.

1. Does a shadow change positions from one **day** to the next?

a. Put a mark, maybe an "X," on the window with tape. During the time of day that the sun shines on the window, the "X" will cast a shadow on the floor. Over a period of time the class will be marking numerous "X's" on the floor to record shadow changes. To prevent excessive confusion from the various markings, you may want to experiment with the best size for the "X" on the window. For example, you probably will not want the shadow too large.



b. Assign each team a time of day to mark the shadow's position. Have the students use tape to mark this shadow position on the floor. Perhaps various teams could check it every half hour. Remember the window will only be in the sun part of the day.

c. Have the teams write the date and time of day on each "X" put on the floor.

d. They should check the next day to see if the shadow falls on the same spot at the same time. If not, have them put down more tape marks showing its new position.

2. Does the shadow change position from one **week** to the next?

a. A week later check the shadow position at the same time of day used the week before. If the shadow was checked on Monday at 12:30, 1:00, 1:30, 2:00, and 2:30, for example, check the shadow at those times the next Monday.

b. If the shadow does not fall on the "X's" taped to the floor the week before, have the teams make new "X's" showing the shadow's new position for the time of day. The children may want to color the tapes for different times and different days.

c. Have the children write the time of day and date on each new "X."

3. Does the shadow change position from one **month** to the next?

a. A month later, check the shadow positions at the same times of day used the month earlier.

b. If the shadows do not fall on the "X's" taped to the floor during the previous month, have the students make new "X's" showing each shadow's new position for that time of day.

c. Have the children write the date and time of day on each taped "X."

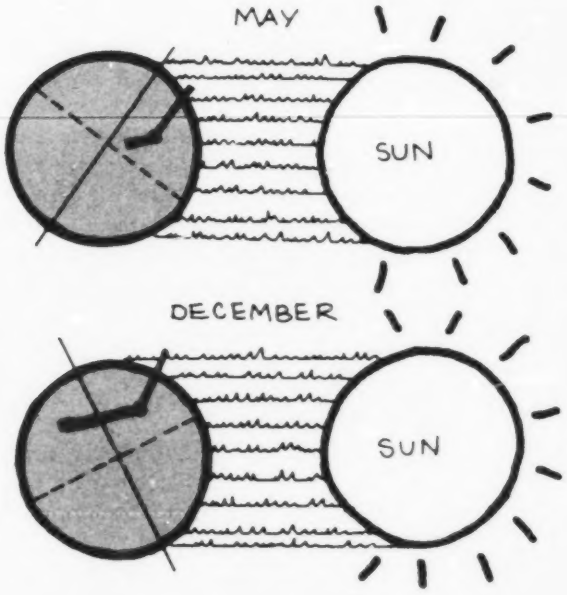
d. Have each team keep a record of the tape position, date, and time, on a map or chart in a notebook, in case the tape is accidentally removed or worn off.

4. Check each succeeding month the same way. Give the class a chance to predict where the shadows will fall each month. Perhaps you could keep account of the closest prediction for each month. Select just one hour, for example 1:00, for the students to make their predictions.

During the month of May, the northern hemisphere is approaching its closest point to the sun for the school year. June 22, the summer solstice, is the actual day that the northern hemisphere is closest to the sun. December 22, the winter solstice, is the day it is furthest from the sun.

For this experiment, suppose you choose to take shadow readings during the first half of December and the last half of May. This should accommodate Christmas vacations in December and summer vacations in June. The May experiments could be adjusted to the first part of May, as your schedule demands, but the closer to June 22, the better.

In December, the northern hemisphere is tilted away from the sun, and the angles that the sun's rays make with the earth are the most oblique they will be all year. This means that the rays are their most indirect, and will create relatively long shadows. By contrast, the angles of the sun's rays in May are more direct, making shorter shadows.



If you measure the shadow of a stick in the ground every day at noon in the first half of December, and then do the same in the last half of May, (December will be eastern standard time—**remember** to adjust for daylight saving time in May), you should find that the December shadows are, generally, longer than the May shadows.

5. At some time during the shadow unit, divide the class into groups and have them try to account for the change in a shadow's position over a period of time. To do this they will have to consider the earth's movement in relation to the sun. Such a discussion might be held during the following activity, "Shadow what time is it in England?" which deals with the same subject.

An alternative would be to line the children up outdoors and take a picture of them and their shadow each month. These pictures must be taken in as close to one-month intervals as interfering weekends will allow. They also must be taken at the same time of day and in the same position each month. Label the pictures with the dates, and tape them side by side on the bulletin board. Have the class note the differences in shadow length and direction from month to month.

C. Have the class make a sun clock (see the earlier note regarding daylight saving time).

1. Ask a child from each team to bring a large sheet of cardboard to school (approximately 3' x 3'). Provide each team with a stake approximately 1½ feet tall and about ½" to 1" thick.
2. Have the children lay the cardboard on the ground and drive the stake vertically through the center of the cardboard into the ground. They should leave about a foot of the stake above the ground, and then fasten the corners of the cardboard with small stakes.
3. Each team should outline the shadow of the center stake for every hour of the school day. You might assign each team an hour to put a mark showing the end of that hour's shadow on the sundials. In other words, when the hour arrives one team could go outside and mark the shadows for all the teams. The children should label their marks with the hour of the day (11:00, 12:00, 1:00, etc.).

4. When the hours are all marked, ask the children if they can tell where the shadow will fall on the half hour. If they can, have them make their marks and see if they were right. If not, they could check to see where the shadow actually falls on the half hour. Ask if they can now

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make marks on their sundial to show where the shadows will fall every 15 minutes.

Ask them to make the mark designating half hours a different type than the mark for hours. The 15-minute marks should also be different from the others.

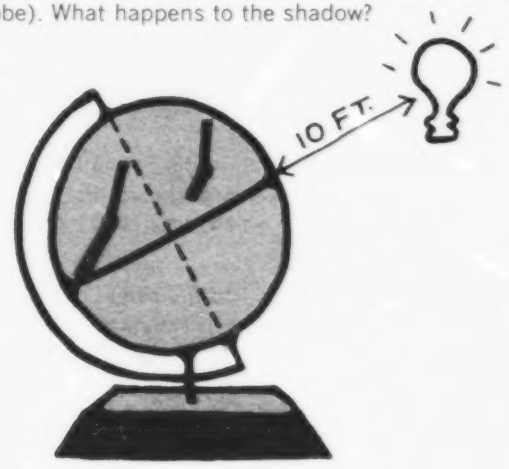
II. Shadow, in what direction am I pointing?

A. Break the class into teams with, say, two children to a team, four teams to a group. Provide each group (4 teams, 8 children) with a lamp. For sharp shadows use a 150-watt clear bulb. Give each team a globe (if possible—if not, use one globe and stagger the shifts of teams which use it at a given time), a one-inch high stick or cardboard figure, a lump of clay, and a 10-foot piece of string.

B. Have the teams push the stick or figure into the clay lump and press the clay onto the globe in the area of the school or home.

C. Using the 10-foot piece of string as a guide, have each team place its globe 10 feet from the lamp. The lamp should be kept at the same level as the equator of the globes, with the north pole up.

D. Have the teams rotate the globe so that there is a shadow cast by the stick. Now imagine that the earth is spinning as it actually does while the teams turn the globe slowly in a west-to-east direction (counter-clockwise as you look down at the globe). What happens to the shadow?



On most globes, the stick will probably not pass under the arm or ring that holds the globe in place. Therefore, the children will have to turn the globe as far as it will go in a clockwise direction and then go back in the other direction (counterclockwise), in order to simulate a complete rotation.

E. Have groups of about four students each discuss the information gathered and relate the information to their previous studies about the changes of the sun's shadow throughout the day. They might consider such questions as:

a. Where is the stick in relation to the lamp when its shadow is longest?
b. About what time is it when the sun shadows are longest?

a. Where is the stick in relation to the lamp when its shadow is shortest?
b. About what time is it when the sun shadows are shortest?

a. Where does the stick go into darkness (no shadow)?
b. About what time is it when sun shadows disappear?

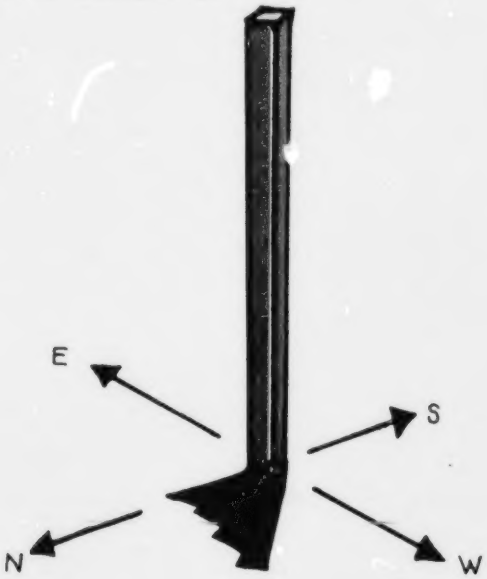
a. Where does the stick come into light (shadow begins)?
b. About what time is it when sun shadows appear again?

F. Initiate a class discussion, raising the following questions only if the class does not:

1. How many times does the earth spin around in a day? (One turn of the globe moved the teams' figures from light to dark.)
2. About what time of the day is it when a shadow is its shortest? (Relate these questions to the setup of the light and globe.)
3. Return to the globe-lamp setup. In what direction does the shadow point when it is shortest? (The answer is north, though this would not be true in the southern hemisphere. The class probably will not know that the sun stays in one band around the equator of the earth and it may be too difficult a problem to tackle at this time.)

G. Try this activity outside: Have teams put a stake in the ground and mark the length and direction of its shadow. Use small stakes at the end of the shadow, and put one stake in the ground every 10 minutes from 11:30 to 12:30. Each team might be assigned a time at which it will be responsible for going outdoors and marking all the teams' shadow lengths. Based on this information from the shadows, which of the stakes signifies it is noon? Based on this information, what direction is north? (The shadow is shortest about noon and it will point

north.) If possible, you might check north with a magnetic compass. The students have now constructed a **shadow compass** and from this should be able to tell the direction of south, west, and east, as well as north.



III. Shadow, how tall is the flagpole?

MATERIALS

string
flagpole (or similar structure)

A. Provide each team with two yardsticks (or one yardstick and string), and clipboards.

B. Let each team select an object whose height can be measured directly. (For example, they may choose a pole used as a support for a volleyball net.)

C. Using the yardstick, have them measure the length of the pole's shadow and record it. (Do not measure the height of the object at this time.)

D. Holding one yardstick straight up, measure the length of that yardstick's shadow by using the second yardstick,

or

cut a length of string the same length as the shadow of the yardstick and measure the string. How many times does the shadow string fit on the yardstick? If the shadow string is longer than the yardstick, how many times does the yardstick fit on the string?

E. The shadow of the pole measured earlier should fit on the pole the same number of times as the shadow of the yardstick fit on the yardstick. (An object and its shadow are at right angles to each other. They comprise two sides of an imaginary right triangle which would be formed by a line connecting the top of the object with the end-point of the shadow. This method of determining the length of an object is based upon the theorem that corresponding sides of similar right triangles are **proportional.**) For example, suppose the shadow of the yardstick (as designated by the length of the shadow string) fits on the yardstick two times; then the shadow of the pole will fit on the pole two times. Thus, if the length of the pole's shadow is one yardstick long, the height of the pole is two times one yardstick, or two yardsticks tall. (Use fractions any way your class can handle them. You might ignore fractions altogether. Or, you might consider ½ or more equal to "1" and less than ½ as "0.")

F. Each team then measures the actual height of the pole (or whatever object it chose), and compares this with the height which was calculated by using shadows.

G. Use this procedure to find the height of objects too tall to measure directly--for example, buildings or flagpoles—by measuring the shadow and dividing by two (or whatever number signifies the number of times that the shadow string fit on the yardstick).

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IV. Shadow, what time is it in England?

For this activity, it will be necessary for the children to recognize the north and south poles of the globe. They will make use of the shadow compass they built earlier, and the technique of determining shadow proportions used in "Shadow, how tall is the flagpole?"

A. Preliminary activities

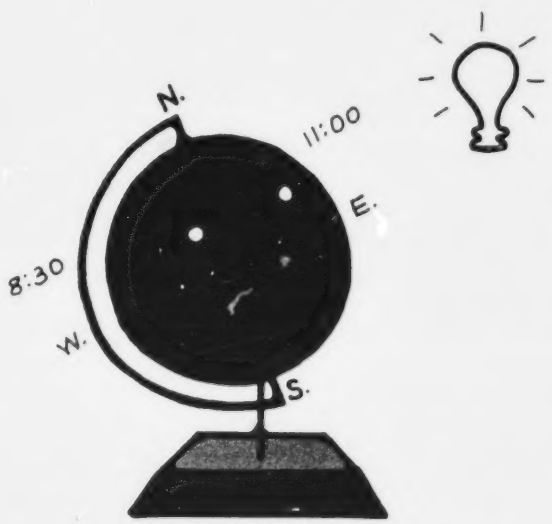
1. Let the children practice telling directions on the globe (east and west, north pole, south pole).
2. Let them practice using their shadow compass.
3. Have each child measure the length of his own shadow outdoors and then cut a piece of string the same length as his shadow. Each child should then have a friend measure his height, and cut a string of this length also. Then ask each child to compare the length of the string for his shadow with his actual height. Depending upon which is longer, how many times does the shadow string fit on the height string or how many times does the height string fit on the shadow string? If your class has not used fractions, count less than half a length as "0" and more than half a length as "1."

Using a toothpick stuck in clay and placed on a table top, have each child move a lamp around until he can get the same relationship between the toothpick and its shadow as he did between himself and his shadow. (The students may want to refer to their work in, "Shadow, how tall is the flagpole?"). For example, if the shadow string is 2½ times as long as the height string, make the toothpick shadow 2½ times as long as the height of the toothpick by moving the lamp. Try this (that is, measuring each child's shadow and height proportion, and making the toothpick and lamp setup correspond), at several different times during the day (morning and afternoon), until everyone is capable of doing it. In a discussion, bring out the fact that the angle of the light from the lamp hitting the toothpick approximates the angle that the sun's rays make with the child.

The direction in which the shadow is pointing will also be important in subsequent activities. See if the children can place the light source so that the toothpick shadow is pointing in the same direction as their shadows were pointing outside.

B. Determining the time in other countries

1. Go outside with the class. Pair off the students and have one child stand still while his teammate measures the length of his shadow. Then, using the shadow compass, have the teammate determine the direction the shadow is pointing. Make determinations at 8:30, 10:30, 12:30, and 2:30.
2. Compare the length of the shadow to the height of the student, as in the preceding illustration.
3. As in **part II** of this section, set up lamps and globes with 10-foot distances between them. Have the lamps at the same level as the equator on the globes.
4. If only one globe is available, assign each team a time when they can use the globe and light, to work steps 5 through 11.
5. Using a one-inch figure, have the children stick it on the globe with clay in the location of their home or school.
6. Have the children move the globe so that the shadow cast by the one-inch figure is in the same proportion and direction as their own shadow was cast at 8:30. Fix the globe in that position.



7. Place a second one-inch figure on the globe. Position it on a line which runs from west to east through the 8:30 figure.
8. Look at the shadow length and direction of the second figure. Judging from the information the children have on their own shadows at 8:30, 10:30, 12:30, and 2:30, ask what the approximate time of day is in the spot where this second figure is located. Can they move it around so it is at the point on the globe where it is about 10:30?
9. Using a third figure have the children locate it on a line extending to the east of the 10:30 figure. Judging from the information they have gathered on their own shadows, ask what the approximate time of day is in the spot where the third shadow is located. Can they move the figure so it is at the point on the globe where it is exactly 12:30?
10. Have the children go through the same procedure with a fourth figure and locate it at a 2:30 position.
11. Rotate the globe from west to east (counterclockwise) until the figure with the 10:30 shadow has an 8:30 shadow. What happened to the figure which originally had the 8:30 shadow? What time do the children think it is where their first figure now is? What happened to the other figures?
12. Each team should write down where it located the sticks on the globe for each of the times. Obtain a map of the time zones and let them check to see how close they came.

SHADOWS WHICH AFFECT LIVING THINGS

The children will compare the number of specimens of a kind of plant in an area that is shaded most of the day, with the number of specimens of that kind of plant found in a sunny area.

A. Take the class outdoors to a part of the lawn which is not shaded by buildings, trees, or other objects.

B. Provide each team with a yardstick, four stakes, and about four feet of twine. With this material they will rope off one-foot-square plots. (Or, use a wire hoop tossed on the ground to delineate an area.)

C. Have each team use the stakes and string to rope off a plot one foot on each side, in an area that is sunny most of the day.

D. Each team may now examine its plot for different kinds of plants. Have each team pick one plant each, of the three most abundant kinds of plants in their plots, and pin them to a centrally located piece of cardboard.

E. From this collection, select a kind of plant which is found in al' or most of the plots. Have each team count the number of specimens of that plant in its plot.

F. Have the teams select other plots in an area which is shaded most of the day but which also has vegetation. (Next to a building?) Have the students carefully count and record the number of specimens of the selected plant in their own plots which are also found in this shaded area.

G. Return to the classroom and have each group of two or more teams combine data. Can they see any significant differences between the sunny and shaded areas? Take an average for the class of the number of selected plants per plot in the shade and compare it with the average number per plot in sunlight. (They could compare the total number if they cannot do averages.) Is there a significant difference? Does shade seem to have a good or a bad effect on this plant's growth?

Important Note: Don't change the **type** of area when changing from a sunny plot to a shaded plot. Otherwise you may introduce variables other than amount of sunlight. For example, the type of soil may be different. If you are studying sunny plots on the school lawn, try to stay on the school lawn to study shady plots.

Ask the children about shade and its effects upon other things in the environment. Ask if shade is necessary. How does shade from some plants affect other plants? How might that affect animals? What happens to plants and animals when there is complete shade (nighttime)?

If the class displays enough enthusiasm, you may want to supplement this unit with **Differences in Living Things** or **Vacant Lot Studies,** both of which are related units in this series.

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THE ENVIRONMENTAL UNITS

Below is a list of the first titles in the Environmental Discovery Series. The ones with order numbers next to them are available as of August, 1972. The others are in preparation and will be available in the coming weeks. Also, ten additional units will be announced soon.

Next to the titles, we have suggested the grades for which each is most appropriate. We emphasize that these are suggested grade levels. The teacher is encouraged to adapt the activities to a wide range of grade levels, and subject areas depending upon the interests and abilities of the students.

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79007	Plants in the Classroom	3-6	$1.50
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